ON THE FIRST COMET OF 1861 AND THE METEORS OF APRIL 20.

By Professor Daniel Kirkwood.

M. Arago was the first to call attention to the frequent appearance of shooting stars in unusual numbers about the 20th of April, and to suggest the theory[1] that they are derived from a ring which intersects the earth's orbit. We are indebted, however, to the late Edward C. Herrick, of New Haven, for the collection of the principal facts by which the suggestion of Arago was fully sustained.

I.

THE GREAT METEORIC SHOWER OF APRIL 20, 1803.

More than thirty-six years after the event the old newspaper accounts of this wonderful display were sought out by Mr. Herrick and rescued from oblivion.[2] The following description of the phenomena as seen at Richmond, Va., is taken from the Virginia *Gazette*, of April 23, 1803.

"*Shooting Stars.*—This electrical phenomenon was observed on Wednesday morning last, at Richmond and its vicinity, in a manner that alarmed many, and astonished every person that beheld it. From one until three in the morning, those starry meteors seemed to fall from every point in the heavens, in such numbers as to resemble a shower of sky rockets. The inhabitants happened at the same hour to be called from their houses by the fire-bell, which was rung on account of a fire that broke out in one of the rooms of the Armory, but which was speedily extinguished. Every one, therefore, had an opportunity of witnessing a scene of nature, which never before was displayed in this part of the globe, and which probably will never appear again. Several of these shooting meteors were accompanied with a train of fire, that illuminated the sky for a considerable distance. One, in particular, appeared to fall from the zenith, of the apparent size of a ball of eighteen inches diameter, that lighted for several seconds the whole hemisphere. During the continuance of this remarkable phenomenon, a hissing noise in the air was plainly heard, and several reports, resembling the discharge of a pistol. Had not the city bell been ringing, these reports would probably have seemed louder. The sky was remarkably clear and serene, and the visible fixed stars numerous the whole night. We are anxious to know at what distance from Richmond this phenomenon has extended. It is hoped that persons who have remarked it in other places will not neglect to inform the public of the particulars; as such information may add in a great degree to the knowledge of meteorology.

Since writing the above, we have been informed that several of the largest of these shooting meteors were observed to descend almost to the ground before they exploded. Indeed, many of those which we saw, appeared to approach within a few yards of the house tops, and then suddenly to vanish. Some persons, we are told, were so alarmed that they imagined the fire in the Armory was occasioned by one of these meteors, and in place of repairing to extinguish the earthly flames, they busied themselves in contriving to protect the roofs of their houses from the fire of heaven."

The display was also witnessed at Raleigh, N. C.; Wilmington, Del.; Schoharie County, N. Y.; Portsmouth, N. H.; and at several points in Massachusetts. The descriptions of the shower as seen at these respective localities declare that, "the heavens seemed to be all on fire from the abundance of lucid meteors;" that they were "too numerous to be counted;" and that "part of the time the light was so great that a pin might be picked up on the ground." The shower, in short, would seem to have been one of the most extensive and brilliant on record, and hence to have been derived from a meteoric cluster of extraordinary density.

According to the catalogues of Biot and Quetelet[3] a great meteoric shower was seen in China on the 16th of March, B. C. 687. This date corresponds with the 20th of April in the nineteenth century. The display was therefore a shower of Lyraids. The interval between this extraordinary apparition and that of 1803 was 2490 years which may be regarded as a multiple of the true period.

The year 558 of our era,[4] midway between those brilliant displays, was the date of another great meteoric shower. The month and day are not given, but we may assume with reasonable probability that it was the great April display. Mr. Herrick found several other showers derived from the same stream. They seem, however, to have been of inferior brilliancy. They will be considered hereafter.

II.

THE FIRST COMET OF 1861.

The first comet of 1861 was discovered by Mr. Thatcher on the 4th of April. It was visible to the naked eye, and had a tail three degrees long. Its elements, calculated by Dr. Oppolzer, of Vienna, are as follows:

ELEMENTS OF THE FIRST COMET OF 1861.

Perihelion Passage	1861, June 3.
Longitude of Perihelion	243° 22′.
Longitude of Ascending Node	29° 55′.
Inclination	79° 45′.
Eccentricity	0.98345.
Semi-axis Major	55.67
Period	415.4 years.
Perihelion Distance	0.9207.
Aphelion Distance	110.425.
Motion	Direct.

Professor George Forbes has shown[5] that the comets of 1444, 1032 and 616 were former apparitions of this comet; the mean of the three periods being 415 years. The dates of ancient perihelion passages would therefore have been about A. D. 201, B. C. 214, and B. C. 629. In 1867, soon after the discovery, by Schiaparelli and others, of the connection between the comets of 1862 and 1866 with the August and November meteors, the probability of a similar relation between the first comet of 1861 and the meteors of April 20th was pointed out by Drs. Weiss and Galle.[6] The orbit of the comet nearly intersects that of the earth in longitude 210°, the point passed by the earth at the epoch of the April meteoric shower. An approximate equality of the periods of the comet and the meteoric stream was thus rendered highly probable.

The facts here collated constitute several very striking coincidences.

1. Dr. Oppolzer's period of the comet, derived solely from observations, is 415 years.

2. The mean period from 616 to 1861 was 415 years.

3. The interval between the great meteoric showers of B. C. 687 and A. D. 1803 is equal to 6 periods of 415 years.

4. The shower of A. D. 558 was midway between B. C. 687 and A. D. 1803.

5. The comet and the meteoric swarm seem to have equal periods.

It is by no means surprising that all returns of the meteoric group have not been recorded. The observations were restricted to the eastern continent; or, as

[1] In 1836.

[2] See Herrick's article in the Am. Journ. of Sci. for July, 1839, p. 358.

[3] Quetelet's Physique du Globe, p. 290.

[4] Quetelet's Catalogue.

[5] In a paper read before the Royal Society of Edinburgh, Feb. 16, 1880.

[6] Astr. Nach., Nos. 1632, 1635, and 1710.

Herrick has remarked, "some of them have doubtless been concealed by clouds, and others witnessed only by barbarians."

But between the great display of B. C. 687 and A. D. 1803, Professor Newton gives the following list of showers at or near the epoch of April 20,[7] viz.: B. C, 15, A. D. 582, 1093, 1094,[8] 1095, 1096, 1122 and 1123. The appearance of 582 ought probably to be rejected. It was two days from the epoch, and the record as quoted by Quetelet may have no reference to shooting stars.[9] The three remaining returns, B. C. 15, A, D. 1093-1096, and 1122-3, indicate a period of about 27 years. Now it is obvious that, at every close approach of meteors to the earth, many must be thrown into new orbits, all of which will pass through the point at which the perturbation occurred. It seems probable, therefore, that at some remote epoch a considerable cluster of this meteoric stream was thrown by perturbation into a new orbit corresponding to a period of 27 years. The change may have been produced by the earth during the passage of the meteoric swarm.

The facts which we have considered apparently indicate that the first comet of 1861, and the April meteors, formed a system in space before entering the solar domain; the latter moving in advance of the former at a distance comparable to the diameter of Neptune's orbit. By planetary perturbation the orbits were transformed into ellipses. If, as supposed by Professor Forbes, the disturbing body was an ultra-Neptunian planet in the vicinity of the present aphelion of the comet's orbit, said planet would probably describe less than 20° of its circuit during the interval between the nearest approach of the two bodies. But in aphelion the comet 1861 I, is too remote from the plane of the ecliptic to be sensibly disturbed by a planet moving in that plane. It seems more probable that the comet, as well as the meteoric group, owes the transformation of its orbit to one of the known major planets. Its radius vector when at its ascending node is about 10. In other words, its orbit approaches very near that of Saturn in longitude 30°. Now, it is remarkable that the interval between the perihelion passages of the meteors and the comet is almost exactly equal to two periods of Saturn. The meteors and Saturn were in the same longitude and in close proximity about B. C. 683, and the comet approached very near the planet at the same point about B. C. 625. The orbits may have been transformed into ellipses by Saturn's influence at these respective epochs. It may be worthy of remark that 11 times the period of the comet are equal to 155 times that of Saturn.

CHEMICAL NOTES.

On Ballo's Supposed Adipic Acid Obtained from Camphor.—On oxidation with chromic acid camphor does not yield adipic acid, but the same oxidation-products as with nitric acid. Chromic acid, however, converts the camphoric acid first formed completely into members poorer in carbon.—J. Kachler.

On the Remarkable Reducing Properties of Potassium Ferrous Oxalate, and on some of the Reactions thus Produced.—Ferrous oxalate is very permanent on exposure to the air, both in a wet and a dry state, and possesses very feeble reducing properties. The solution of ferrous oxalate in potassium oxalate, as well as the solid double salt, takes up oxygen greedily, and passes into potassium ferric oxalate. Its affinity for oxygen is equal to that of an alkaline ferrous hydrate, or of ammoniacal cuprous chloride, or of pyrogallic acid in an alkaline solution. The double oxalate exerts its reducing powers, not merely in alkaline, but in neutral, and even acid solutions. The solution quickly reduces platinum chloride and silver nitrate to metal. Silver chloride, bromide, and iodide are reduced completely, but more slowly. Copper acetate is reduced very slowly to cuprous oxide, and even to metal With the aid of heat mercuric chloride is reduced to metal. Recently precipitated Prussian blue is reduced to white ferro-cyanide of potassium. Indigo blue is reduced to white indigo, and solutions of sulphindigotic acid are rapidly decolorised.—J. M. Eder.

On the Acids $C_8H_{14}O_4$ Formed from Butyric Acid. Besides a volatile oily acid, probably identical with isocrotonic acid, there are formed by the reaction of suberic and bromobutyric acid, two acids agreeing in composition with suberic acid, but distinctly different from each other, and from the two isomeric acids produced by a corresponding reaction with brom-isobutyric acid. There exist, therefore, five isomeric suberic acids.—Carl Hell and O. Mulhauser.

A New Synthesis of Phosphenyl Sulpho-Chloride.—Twenty parts phosphenyl-chloride are placed in a small flask with a reflux condenser, and five parts sulphur-chloride are slowly added by means of a dropping-funnel. After the reaction is over, the flask is set in a freezing mixture of Glauber's salt and hydrochloric acid. Pale yellow crystals of phosphenyl-tetra-chloride are formed, from which the liquid is separated by decantation, then shaken with water, dried and rectified. The yield is almost quantitative.—H. Koehler.

More Particular Observations on the Action of Potassium Carbonate upon Isobutyl-aldehyde.—F. Urech places about 3 grms. pure isobutyl-aldehyde in a narrow test tube graduated in half millimetres. With a lens it is possible to read accurately quarter millimetres. After 3 decigrms. of finely-powdered recently-ignited potassium carbonate have been added, the tube is closed, set in a horizontal position, and the level is read off every five minutes for forty-eight hours. The liquid will be found to have sunk from 21.50 to 14.50 degrees.

At a meeting of the Société Industrielle of Mulhouse, it was stated that tin sulphocyanide, formed by the double decomposition of calcium sulphocyanide and tin oxalate, is found very useful in calico printing.

For printing cotton with the azo-colors, Dr. Allrich proposes to dissolve 100 grms. of the color in five times its weight of water; then to make up a solution of sodium stannate or aluminate at 15° B., to every litre of which are added 20 grms. alizarin oil. Of this mixture 150 grms. are incorporated with the color, which is then thickened with starch and printed. After printing the pieces are steeped for an hour in lead or barium acetate or barium chloride at 5° to 10° B., and washed in cold water.

CORRESPONDENCE.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

To the Editor of "Science:"

In reference to the correction of one of my statements made in your issue of the 29th inst. by Dr. Burt G. Wilder, I would say that I accept the criticism in all its bearings. The view which Dr. Wilder expresses regarding the upper wall of the third ventricle being constituted by the *ependyma* stretched across between the *habenulæ* of the pineal gland, was once entertained by myself (in accordance with the orthodox view of embryologists since the time of Rathke), and was the one which Dr. Wilder may perhaps recollect I expressed to him in conversation last year. I return to that view again. My abandonment of it was due to the confounding of two distinct questions, *i. e.*, the question of the true inner boundary of the floor at the lateral ventricle and the true upper and outer boundary of the third. The view I should have credited to Wilder and Hadlich, is that the *lateral ventricle does not* extend over the thalamus. My misapprehension of Wilder's statement is based on the fact that it rested on a verbal communication. That I mentioned it at all was

[7] Am. Jour. of Science, July, 1863.

[8] "At this period, so many stars fell from heaven that they could not be counted. In France the inhabitants were amazed to see one o thenmsfi great size fall to the earth, and they poured water on the spot, we hish their exceeding astonishment smoke issued from the ground with aoot f-- ing noise."—Herrick's Catalogue. This record is of great interest as indr cating the fall of an aerolite during the shower of meteors.

[9] "A Soissons, on voit le ciel en feu. Une pluie de sang tombe sur Paris."